UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
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JAN 0 9 2016

Mr. Thomas Barron, Chief
Division of Water Quality Standards
Bureau of Clean Water
Department of Environmental Protection
Rachel Carson State Office Building
400 Market St.
Harrisburg, PA 17101

Re: Comments on the "Determination of Copper Water Effect Ratio for Abers Creek and Holiday Park Sewage Treatment Plant" (Report #BRF/ETF15-006, October 16, 2015)

Dear Mr. Barron:

On December 10, 2015, the U. S. Environmental Protection Agency (EPA) Region III Office of Standards, Assessment & TMDLs (OSAT) received for comment the "Determination of Copper Water Effect Ratio for Abers Creek and Holiday Park Sewage Treatment Plant" (Report #BRF/ETF15-006, October 16, 2015) from the Pennsylvania Department of Environmental Protection (PADEP). The submittal included the Abers Creek copper water-effect ratio (WER) for the Plum Borough Municipal Authority, PA (PBMA) for Holiday Park Sewage Treatment Plant (HPSTP), which PADEP is proposing to include in NPDES permit PA0035360. The purpose of this letter is to provide PADEP EPA's comments on this proposed WER. We are providing comments on the specific WER study completed for the HPSTP, as well as a general recommendation for use of the Biotic Ligand Model (BLM), EPA's current recommended criterion for copper under section 304(a) of the Clean Water Act, because it represents the best available science to derive criteria for copper.

1. General Background on Metals Criteria

Criteria for the protection of aquatic life may be based on certain water characteristics (e.g., pH, temperature, hardness, dissolved organic carbon (DOC), and others) because water chemistry can influence a pollutant's bioavailability and toxicity. For metals in particular, EPA recommends expressing the aquatic life criteria as functions of chemical constituents of the water, because those constituents can form complexes with metals and render the metals biologically unavailable, or compete with other metals for binding sites on aquatic organisms[1]. Additionally, in 1993, EPA recommended that criteria for metals be expressed as dissolved (rather than total) metal concentrations because the concentration of dissolved metal better approximates the toxic fraction[2].

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[1] Water Quality Standards; Establishment of Numeric Criteria for Priority Toxic Pollutants; States' Compliance - Revision of Metals Criteria," 60 Federal Register 86 (May 4, 1995), pp. 22229 – 22237.
[2] Prothro, M. (1993, October 1) *Office of Water Policy and Technical Guidance on Interpretation and Implementation of Aquatic Life Metals Criteria* [Memorandum]. Washington, DC: United States Environmental Protection Agency. https://www3.epa.gov/npdes/pubs/owm0316.pdf

EPA aquatic life criteria for metals, such as EPA's previous (1985) recommended national criteria for copper, historically addressed the reported effects of hardness on metal toxicity using empirical regressions of toxic concentrations versus hardness for available toxicity data across a wide range of hardness values. Such regressions provided the relative amount by which the criteria change with hardness, but have certain limitations. The regressions incorporated not just hardness, but any other factor that was correlated with hardness in the toxicity data set used for the regressions, particularly pH and alkalinity. Although these regressions therefore address more bioavailability issues than hardness alone, they best apply to waters in which the correlations among hardness, pH, and alkalinity are similar to the data used in the regressions. The separate effects of these factors are not addressed for exposure conditions in which these correlations are different. In addition, some physicochemical factors affecting metal toxicity, such as organic carbon, are not addressed at all. (*See Aquatic Life Ambient Freshwater Quality Criteria – Copper, 2007 Revision*[3], hereafter referred as "*BLM Criteria Document*") at 4.

2. National 304(a) Recommended Criteria for Copper

Because of the limitations of these past approaches for addressing bioavailability in metals criteria, EPA recognized a need for an approach that (l) explicitly and quantitatively accounted for the effect of individual water quality parameters that modify metal toxicity and (2) could be applied more cost-effectively and easily, and hence more frequently across spatial and temporal scales. To meet those goals, EPA developed and issued the 2007 revised recommended copper criteria using the biotic ligand model (BLM) (See *BLM Criteria Document*). In addition to better accounting for the effects of individual parameters while at the same time reducing costs, the *BLM Criteria Document* also incorporated the latest scientific information, including updated toxicity information for six sensitive species (*Ceriodaphnia dubia, Lithoglyphus virens, Scaphofeberis* sp., *Actinonaias pectorosa, Hyalella azteca, and Juga plicifera*), which include a freshwater mussel. EPA recommends use of the BLM to develop criteria for copper, including site-specific criteria.

3. EPA Guidance on Deriving Site-Specific Criteria for Copper

The application of metals criteria to a specific site is complex due to the site-specific nature of metals toxicity. Factors to be considered include: toxicity specific to effluent chemistry; toxicity specific to ambient water chemistry; different patterns of toxicity for different metals; evolution of the state of the science of metals toxicity, fate, and transport; resource limitations for monitoring, analysis, implementation, and research functions; concerns regarding some of the analytical data currently on record due to possible sampling and analytical contamination; and lack of standardized protocols for clean and ultraclean metals analysis[4]. States have the key role in the risk management process of balancing these factors in the management of water programs, but EPA has provided guidance since the 1990s to assist states in adjusting national recommended criteria site-specifically.

EPA has historically developed several procedures for deriving site-specific aquatic life copper criteria. They include: the 1994 *Interim Guidance on Determination and Use of Water-Effect Ratios for*

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[3] USEPA. 2007. Aquatic Life Ambient Freshwater Quality Criteria - Copper. EPA-822-R-07-001.

[4] Prothro, M. (1993, October 1) *Office of Water Policy and Technical Guidance on Interpretation and Implementation of Aquatic Life Metals Criteria* [Memorandum]. Washington, DC: United States Environmental Protection Agency. https://www3.epa.gov/npdes/pubs/owm0316.pdf

Metals ("*Interim WER Guidance*")[5] which includes as an appendix the option of a Recalculation Procedure; the subsequent 1997 EPA memorandum titled "*Modifications to Guidance Site-Specific Criteria*"[6] which provided three clarifying documents on the recalculation procedure and use of the water-effect ratio (WER) procedure with hardness equations; and the 2013 *Revised Deletion Process for the Site-Specific Recalculation Procedure for Aquatic Life Criteria*[7]. The Recalculation Procedure (or derivation of a SSC) is intended to take into account relevant differences between the sensitivities of the aquatic organisms in the national dataset that EPA used in developing its recommendations for hardness-based criteria as compared to the sensitivities of organisms that occur at the site. The WER, on the other hand, characterizes the bioavailability of metals at a site. EPA also published the 2001 *Streamlined Water-Effect Ratio Procedure for Discharges of Copper*[8] as a complement to the *Interim WER Guidance*, when copper concentrations are elevated primarily due to continuous point source effluent.

EPA provided the WER procedures to address the modifying effects of site water chemistry on bioavailability of copper more accurately than the hardness regressions. The WER is a biological method that accounts for any difference that exists between the toxicity of a pollutant in laboratory dilution water and its toxicity in site water. A WER is calculated by dividing the acute toxicity of the metal in site water by the toxicity of the copper determined in standard laboratory water. The standard laboratory water toxicity is used as the denominator to reflect that this toxicity is measured in test water that has water quality characteristics representative of the test waters used to develop the water quality criteria toxicity database, at least as a good approximation. The State's hardness-based acute and chronic criteria concentrations are then multiplied by this ratio (i.e., the WER) to establish site-specific acute and chronic criteria that reflect the effect of site water characteristics on toxicity. However, a WER accounts only for interactions of water quality parameters and their effects on metal toxicity to the species tested and in the water sample collected at a specific location and at a specific time (*BLM Criteria Document* at 4).

Since 2007, EPA has recommended the use of the BLM over the use of the WER for deriving freshwater site-specific aquatic life criteria for copper. The BLM is a metal bioavailability and toxicity model that uses comprehensive information on water chemistry conditions and parameters in a water body to calculate site-specific criteria. The BLM incorporates more recent toxicity data than older procedures, and therefore represents the most scientifically defensible approach to deriving site-specific criteria for the protection of aquatic life. The BLM also considers the influence of both biotic and abiotic (organic and inorganic) ligands in the calculation of the bioavailability of metals to aquatic organisms. Thus, the BLM better accounts for site-specific conditions affecting copper bioavailability and toxicity. *BLM Criteria Document* at 4-5, 16-17 (describing the limitations of hardness-based and WER copper criteria in comparison with the BLM). EPA's Science Advisory Board (SAB) concluded in its 2000 review of the BLM that the BLM can "significantly improve predictions of the acute toxicity of certain metals across an expanded range of water chemistry parameters compared to the WER."[9]

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[5] USEPA. 1994. Interim Guidance on Determination and Use of Water-Effect Ratios for Metals. EPA-823-B-94-001.
[6] Wiltse, J. (1997, December 3). *Modifications to Guidance Site-Specific Criteria* [Memorandum]. Washington, DC: United Stated Environmental Protection Agency. https://www.epa.gov/sites/production/files/2015-01/documents/modification-int-wer.pdf
[7] USEPA. 2013. Revised Deletion Process for the Site-Specific Recalculation Procedure for Aquatic Life Criteria. EPA-823-R-13-001.
[8] USEPA. 2001. Streamlined Water-Effect Ratio Procedure for Discharges of Copper. EPA-822-R-01-005.
[9] USEP A Science Advisory Board. 2000. Review of the Biotic Ligand Model of the Acute Toxicity of Metals. EP A-SAB-EPEC-00-006. p.1.

The 2001 streamlined WER protocol requests corresponding measurements of alkalinity, pH, DOC, and total suspended solids (TSS) "to provide ancillary information for understanding the chemistry influencing the observed WER results and for providing a link with the Biotic Ligand Model (BLM) which is ultimately intended to replace the WER toxicity test procedures for copper."[10]

4. Comparison of WER and BLM

As discussed above, before the BLM was developed, EPA recommended the WER for copper to provide for site-specific adjustments to account for variations in water chemistry other than hardness. Use of the WER presents a number of problems. The WER involves site-specific toxicity testing which can be resource-intensive and difficult to conduct for all relevant environmental conditions. Also, the hardness-based equation is less accurate because it does not benefit from the updated toxicity dataset used to develop the BLM, and it accounts for only one of the many variables affecting bioavailability of copper in real world conditions, and that variable (hardness) is less strongly predictive of bioavailability than DOC content. Furthermore, WER outcomes are subject to the many and various uncertainties inherent in extrapolating limited laboratory results with cultured lab test species to field scale protection of a resident aquatic community assemblage. In WER tests a few unusual results can have a large impact on conclusions about potential copper toxicity at a site. The WER represents the water chemistry present at a site only at the time the samples were collected and in practicality and general application is limited to collecting just a few representative points. In contrast, the BLM is capable of predicting protective levels for criteria-setting across a wide range of conditions (e.g., variations in pH, DOC, hardness, etc.) using multiple samples integrated over time.

In contrast to the WER, the BLM can address a broad range of environmental variables across a given site over the course of time. This has the benefit of providing confidence and understanding of why a particular result is obtained in a manner consistent with a scientific understanding of water chemistry and its effects on biota, and that can be replicated across sites to explain both commonalities and differences in observed outcomes. The SAB stated that the BLM's "predictiveness over a wide range of environmental conditions makes the BLM a more versatile and effective tool for deriving site-specific WQC than the WER." (SAB Report, p.12).

5. EPA's Scientific Evaluation of the Proposed Copper WER for HPSTP Discharge

For the above reasons, when determining whether the proposed WER for dissolved copper applicable to HPSTP's discharge is based on a sound scientific rationale and would be protective of aquatic life, consistent with both EPA's 2001 *Streamlined WER Procedure* and the 2007 *BLM Criteria Document*, EPA's review of the WER included a comparison of the WER results against results that would be derived using the BLM. It is appropriate to make this comparison for the following reasons: 1) as described above, the BLM represents the most current and best science for evaluating whether a given copper concentration protects aquatic life; and 2) the BLM allows consideration of site-specific chemical parameters that influence the expression of copper toxicity, and their variability over time, in a manner that examining WER results by themselves cannot. This latter factor is important because it helps EPA ascertain the underlying factors affecting bioavailability and toxicity of copper at a site and whether a particular WER result is scientifically defensible and protective of local aquatic species. Greater consideration of site-specific factors makes the BLM more accurate than the WER in predicting levels of copper that protect aquatic life.

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[10] USEPA. 2001. Streamlined Water-Effect Ratio Procedure for Discharges of Copper. EPA-822-R-01-005. pp. 4-5, 11, 15

Depending on data inputs provided and the full range of spatial and temporal variability at a site, the BLM typically produces a range of outcomes (called "instantaneous water quality criteria" or "IWQCs"). To ensure protectiveness under critical conditions, EPA examines the range defined by the distribution of IWQCs. If the WER-derived WQC fall within or below this range, then EPA would consider this to be a scientifically defensible result indicating protectiveness under a set of site-specific conditions (although further evaluation of whether this result reflects critical conditions may be necessary). However, if the WER-derived WQC fall above this range, then this is evidence that the WER result is not protective. EPA could also compare individual point values of BLM IWQC representing conditions tested under the WER procedure to WER-derived WQC. If these BLM point value IWQCs are lower than the associated WER-derived criteria, then this is evidence that the WER is not protective. The latter approach is the one EPA took in evaluating PBMA's submitted WER given that PBMA only provided BLM input parameters for two sampling dates.

As part of our review, EPA derived criteria using the BLM and the same chemical data that was used to derive the WER of 6.4 to evaluate the protectiveness of the PBMA WER. EPA compared these BLM-derived criteria to the site-specific criteria calculated using Pennsylvania's current copper criteria multiplied by the derived WER of 6.4.

Table 1 below lists the parameters EPA used for the BLM calculations. For all input parameters except temperature and humic acid percentage, EPA used data from Table 4 on page 9 of the Tetratech Report # BRF/ETF15-006, titled "Determination of Copper Water Effect Ratio for Abers Creek and Holiday Park Sewage Treatment Plant," dated November 25, 2015. The report did not provide data on ambient water temperature or percentage of DOC as humic acid. EPA assumed 10 percent humic acid based on the default value from the *BLM Criteria Document* and used the same temperature as was used to run the WER test, as reported in Table 2 on p.5 of the above-referenced Tetratech report. The same table reported the dilution ratio of the simulated downstream water as 50%.

<u>Table 1: Biotic Ligand Model Data Inputs</u>

Location ('Site label')	**WER 8/10/2015**	**WER 9/9/2015**
Sample Date ('Sample label')	**simulated downstream**	**simulated downstream**
Ambient Water Temperature	25	25
pH	7.7	7.7
DOC	5.9	4.6
Humic Acid % of DOC (default is 10%)	10	10
Ca Total	45	34
Mg Total	10	8.6

Na Total	84	66
K Total	9.4	8
Sulfate	69.2	66.3
Chloride Total	83.2	58.5
Alkalinity	132	92

Table 2 below shows the resulting acute (CMC) and chronic (CCC) criteria values calculated using Pennsylvania's hardness-based equation, the proposed site-specific WER-adjustment to the hardness-based equation, and the BLM. The BLM results represent acute and chronic IWQC at two discrete points in time from the 9/9/2015 and 8/10/2015 sampling events. These IWQC may or may not reflect critical conditions at the site.

Table 2: Comparison of Currently Applicable Hardness-Based Copper Criteria, Proposed WER-Derived Criteria, and BLM-Derived Criteria

	Acute CMC (ug/L) (Dissolved)	**Chronic CCC** (ug/L) (Dissolved)
Currently Applicable Hardness-Based Criteria[1]	13	9.0
Proposed WER-Adjusted Criteria[1]	83.2	57.6
BLM-Derived Instantaneous Water Quality Criteria based on 9/9/2015 Simulated Downstream Water Sample	32	20
BLM-Derived Instantaneous Water Quality Criteria based on 8/10/2015 Simulated Downstream Water Sample	44	28

[1]Calculated using assumed water hardness of 100 mg/L as CaCO3, per table E1 on p.ii of Tetratech report # BRF/ETF 15-006, titled "Determination of Copper Water Effect Ratio for Abers Creek and Holiday Park Sewage Treatment Plant," dated November 25, 2015

40 CFR § 131.1 l(a) requires states to adopt criteria that protect the designated use. Such criteria must be based on a sound scientific rationale. National Pollutant Discharge Elimination System (NPDES) permits must derive from and comply with water quality standards. The WER-adjusted criteria are approximately two to three times higher than the BLM-derived criteria. EPA therefore cannot conclude that the proposed WER is protective of the designated aquatic life use because the BLM results represent a superior indicator of protectiveness for the reasons articulated above in this enclosure.

The value of the information represented by the BLM result cannot be ignored or set aside in deference to a WER value. EPA developed the BLM to reflect site-specific conditions in the receiving water that affect the expression of copper toxicity and also utilize the full toxicity database of aquatic organisms. A WER relies on transferring the result of just a few laboratory tests using site water for a limited number of species to the field. This introduces many uncertainties, such as whether the tolerance of test species in the laboratory reflects the impact to resident species in the receiving water. EPA's documented scientific judgment, expressed in criteria publications that have undergone rigorous external scientific peer review and public review, is that the BLM provides the most accurate means to assess the impact of copper toxicity for a wide range of species and site conditions. EPA's criteria derivation methodology encompasses many careful considerations to ensure protectiveness, and the Agency views a significant deviation (such as is the case with the proposed WER) as compromising the level of protection necessary to protect the associated designated use.

The input parameters (listed in Table 1) vary over space and time in natural waters. EPA recommends that PBMA collect multiple samples at different points in time to derive BLM criteria fully reflective of site variability. This way, PBMA can ensure that the most bioavailable conditions are represented, and therefore the resulting criteria will be protective.

If you have any questions, please do not hesitate to contact me at (215) 814-5717.

Sincerely,

Evelyn S. MacKnight

Evelyn S. MacKnight, Associate Director
Office of Standards, Assessment & TMDLs

cc: Chris Kriley, PADEP
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